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Social Neuroscience

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PSYCHOLOGY TEACHERS UPDATE

Psychology Teachers Update is designed to give a brief overview of the main developments in the different areas of psychology. There is a proliferation of journals and research, and it is very difficult to keep abreast of the latest trends, particularly in the many and varied areas of psychology.

Each issue of Psychology Teachers Update will cover particular topics, and summarise the main research directions and findings in the last ten to fifteen years approximately. The aim is to give teachers the feel of what is happening in that area of psychology.

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INTRODUCTION

Social neuroscience (SN) [1] [2] "is an integrative field that examines how nervous, endocrine, and immune systems are involved in sociocultural processes" (Harmon-Jones & Devine 2003 p590). It builds on ideas from social, developmental and cognitive psychology, as well as evolutionary biology, neuropsychology and computer science (Blakemore et al 2004).

It is the study of "the relationship between neural and social processes" (Cacioppo et al 2003) which developed in the 1990s due to the advances in neuroimaging technology.

The focus is upon the "biological underpinnings of social psychological phenomena", which has increased in interest recently, though it has been there for 30-40 years (Harmon-Jones & Devine 2003).

It is hoped that the "power of neuroscientific methods" can "address processes and mechanisms that would not be possible with the traditional methodological tools of the social psychologist" (Harmon-Jones & Devine 2003).

Cacioppo and Visser (2003) outlined three principles for organising "trans-disciplinary research" in SN:

i) Multiple determinism - A social behaviour can have multiple causes or antecedents. For example, aggression can result from neurochemical changes, frustration, or sociopolitical issues (eg: national identity and defence of nation).

ii) Non-additive determinism - The whole cause is not necessarily the sum of the parts. Practically, this means that the causes for a behaviour may vary between situations.

The focus upon the physiological level of analysis needs to be seen in a social context. For example, Haber and Barchus (1983) found little difference in behaviour between primates given an amphetamine or a placebo. But when the individual animal's position in the social hierarchy was considered, amphetamines increased dominant behaviour in individuals high in the social hierarchy and increased submissive behaviour in those lower down. "A strictly physiological (or social) analysis, regardless of the sophistication of the measurement technology, may not have revealed the orderly relationship that existed.." (Cacioppo and Visser 2003 p652).

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[1] Also called "social cognitive neuroscience" or "social psychophysiology" (Harmon-Jones & Devine 2003).

[2] The term "social neuroscience" first appeared in an article in 1992 (Cacioppo and Berntson 1992).

iii) Reciprocal determinism - There is a two-way interaction between physiological and social levels of analysis. Physiological aspects can cause social behaviour, and social factors can cause physiological changes.

Methods Used

The most commonly used neuroimaging technique is functional magnetic resonance imaging (fMRI) which measures the oxygen level in blood (blood oxygen level dependent (BOLD) fMRI). It is assumed that greater oxygen in a region of the brain is a sign of activity. However, blood flow response is usually 1-2 seconds after electrical activity in the brain. Where this is important, fMRI can be complemented by measurement of event-related brain potential (ERP) (Cacioppo et al 2003).

SN is more than just the "brain mapping of social processes" using fMRI, it includes work with individuals with brain injury (Harmon-Jones & Devine 2003).

Neuroscientific methods can aid in understanding social psychological processes. For example, Lieberman et al (2001) found that amnesiac patients changed their attitudes in response to cognitive dissonance despite no conscious recall of the situation that produced the dissonance. Thus conscious awareness of the dissonance of attitudes may not be necessary for cognitive dissonance to produce attitude change (appendix A).

SN seeks to understand the genetic and physiological mechanisms underlying human social behaviour, and, for some researchers, this can be done effectively by using animal models (Cacioppo et al 2007). In particular, genetically engineered (knockout) animals, usually mice, have been studied. For example, mice with oxytocin knockout (removal of the gene that codes for the production of the hormone oxytocin) do not recognise mice they have previously encountered (Ferguson et al 2000). While infusion of oxytocin into the amygdala of these mice restores social recognition (Cacioppo et al 2007).

Animal models, however, have limitations in their application to human social behaviour. In particular, the complexity of human social behaviour compared to other animals, while the focus on individual genes is too simplistic.

SOCIAL COGNITION

Neuroimaging techniques have shown that processes related to social cognition are associated with three particular brain regions - the medial prefrontal cortex (MPFC), temporo-parietal junction, and the precuneus/posterior cingulate (Mitchell 2008).

From this type of research has arisen questions about social cognition. For example, is social cognition simply a variation on non-social cognition? In other words, is person perception a sub-category of overall perception? If the answer is no, it would suggest "a set of cognitive processes that are simply not required by other kinds of thought" (Mitchell 2008).

Activity in the MPFC seems to relate to social cognition, and in particular, to the mental processes involved like inferences about the mental state of others. Fletcher et al (1995), in one of the first neuroimaging studies of social cognition, found different MPFC activation depending upon the mental task participants were asked to perform while reading a story - attribution of a character's behaviour (social cognition) or think about the physical causality of events (non-social cognition). This difference in the MPFC was enough to be called a "signature" of social cognition (Mitchell 2008).

More recently, Mitchell et al (2004) confirmed a difference using fMRI while participants formed an impression of a character in a story (social cognition) or memorised part of the story (non-social cognition). Only the former produced activity in the MPFC.

However, other studies show that social cognition and non-social cognition use overlapping areas of the brain for some tasks (Mitchell 2008).

Neuroimaging studies have also shown that the "social cognition" parts of the brain may have primacy over other areas of the brain. For example, these areas show a higher metabolic rate when resting - "the human cognitive system may be in a state of continuous readiness to encounter other minds" (Mitchell 2008).

Social Evaluation

Cunningham et al (2003) noted that: "The seemingly ordinary act of assigning valence — good and bad — is crucial for survival, guiding behaviour toward or away from a significant object in the immediate environment or in anticipation of future rewards and punishments in goal attainment" (p639). SN has produced work on the brain systems involved in this process, which

seems to be different for automatic and conscious social evaluation.

Studies in social psychology (eg: Fazio et al 1986) established that evaluations on the good-bad dimension are automatic (within hundreds of milliseconds) (ie: without conscious intention or awareness). This process seems to be linked to the amygdala, whereas conscious evaluation does not.

Cunningham et al (2003) showed this distinction with fMRI as participants responded to names of famous people as "good" or "bad" people (automatic evaluation) or as historical or current people ("past"/"present") (control condition). As with many neuroimaging studies, a small sample (n = 12) was used in this related design experiment.

There were four runs per person, each containing 24 names equally divided between the four tasks (good/bad, past/present). A cue indicated which task prior to the appearance of the name for 1.5 seconds. The data were converted into contrast maps which showed brain activity for each task.

It was found that greater amygdala activity occurred for "bad" names, and there was greater activity in the medial and ventrolateral prefrontal cortex for the good-bad tasks compared to the control tasks. Participants also responded significantly quicker on the good-bad tasks, and for the good names than the bad names.

For "self-relevant processing" the medial prefrontal cortex is involved with one region active in self-reflection and another in self-description (Cacioppo et al 2007).

Fox et al (1995) found differences in frontal cortex activation among children viewed as socially competent or socially withdrawn. The former showed greater relative left frontal activity, and the latter greater right activity.

Attribution

One finding that has generated recent interest is the discovery of "mirror neurons" in the ventral pre-motor cortex of macaque monkeys (Gallese et al 1996). These neurons are activated during a grasping task, and when observing another monkey doing the grasping task. Brain activity in response to watching other humans (not robots) perform behaviours has been found in subsequent studies with humans (eg: Rizzolatti et al 1996). This suggests a role in attributing intention to the behaviour of others and the self (Blakemore et al 2004).

In terms of the attribution of intention, Castelli et al (2000) found this behaviour in relation to the

movement of geometrical shapes (eg: one triangle "mocking" another) and that specific brain activation was not present for random movement of the shapes.

Attribution of intention is part of the process of understanding others' minds, which has an evolutionary advantage, particularly in relation to detecting cheaters. The superior temporal sulcus is active in both cases (Blakemore et al 2004).

CAUTIONS ABOUT SOCIAL NEUROSCIENCE

There are concerns about placing too much emphasis on the use of fMRI. Seeing a picture of the active brain is very attractive, and there "is an intuitive appeal to viewing a social psychological construct or research enterprise as more legitimate, respectable or 'scientific' if the social psychological measure, process, or response is shown to co-vary with some event in the brain" (Cacioppo et al 2003 p652). So Cacioppo et al (2003) urged caution about excitement over studies that simply show brain activity during a social behaviour as it is already known that social behaviour involves the brain.

Furthermore, there is also a temptation to use fMRI to search for the brain areas associated with particular social behaviours. It used to be assumed that memory, for example, was localised to a single area in the brain, but the current view is that complex behaviours do not map onto a single brain area. It is a "category error" to seek to map a behaviour to a particular brain centre in a one-to-one fashion (Cacioppo et al 2003). It is like a modern-day phrenology [3].

Take this example which shows the dangers of assuming brain localisation of social behaviour. Phelps et al (2000) found activation of the amygdala in the fMRI scanner of White participants in response to Black faces, but not in response to White faces. Thus the amygdala seems to be the "home" of indirect/unconscious prejudice/racism. Phelps et al (2003) then tested individuals with damage to the amygdala. Even though this area of the brain showed no activation (because of the damage), these individuals showed similar unconscious prejudice towards Black faces based on other measures. Does this mean that the first study found a spurious correlation between amygdala activity and unconscious prejudice?

Yet fMRI shows brain activity localised in parts of the cortex for different social behaviours. Cacioppo et al (2003) viewed these observations as "a specific processing component being related to the activation of the specific cortical region" or it "may reflect a region that is part of a more distributed network of processing

[3] "Yet interpretations frequently stated or implied about functional imaging data.. suggest that, if not careful, functional brain imaging could be viewed as no more than a modern and extraordinarily expensive version of 19th-century phrenology" (Raichle 2003 p759). So "Taking a lesson from the immense success of cognitive neuroscience, those interested in social neuroscience need to focus on the training of a new generation of social scientists who understand and can effectively use functional brain imaging and the other new tools of neuroscience" (Raichle 2003 p763).

mechanisms that work together to perform the task" (p654).

Cacioppo et al (2003) also warned against inferences from fMRI studies that they called the "affirmation of the consequent". This is the assumption that brain activity in one condition of an experiment and not in another must account for any differences. For example, Bartels and Zeki (2000) showed seventeen participants pictures of their romantic partner or three friends of the same age and sex as the romantic partner. There were small differences in brain activity patterns between viewing the romantic partner and viewing the friends. It would be a logical flaw, argued Cacioppo et al 2003, to say that the differences are romantic love or friendship. It requires multiple methods to clarify any differences, not just the use of fMRI.

It is a mistake to study social aspects of human behaviour in isolation assuming that social cognitive processes are the same as cognitive processes; for example, that social perception can be tested in the same way as object perception.

Neuroimaging tends to concentrate upon an individual brain even when the participant believes they are interacting with another person, but the "natural reciprocity of human communication requires that we look at two brains and not just one" (Blakemore et al 2004 p221). Raichle (2003) countered: "It is that knowing the implementing architecture of a complex task, no matter how tightly constrained and controlled in the somewhat artificial environment of an imaging study, is a very important element in the process of understanding the basic mental operations orchestrated for its instantiation" (p760).

General Cautions About Neuroscience

Neuroscience generally has advocates who emphasis a golden future:

> The coming decades will be a time when neuroscience really goes forward exponentially we will be able to influence the basic human condition, our cognitive abilities, our mood, and even perhaps our romantic relationships. Further down the track, we may even be interfering in early human development or contributing to augmenting early human development or even genetic engineering (Saulescu 2010).

While there are critics of such claims:

> The attraction of a brain scan is it appears to be objective data. In a world of values and arguments and impressions, here you've got an objective datum, a bit of the brain lighting up. The fact that that datum actually is irrelevant doesn't seem to matter too much - it's objective - and of course it does have the glamour of high science, of leading edge technology, and people are suckers for technology (Tallis 2010).

As with any method, there are issues of validity and reliability. The validity of fMRI is evidence of brain activity in an area based on oxygen use, and this is generally agreed (Lovett 2010). But Bennett and Miller's (2010) review of articles using fMRI has challenged reliability. They found that there was a 50% correlation between activity in the same brain area in the same person between the first and second tests on the same cognitive processes.

Neuroscience is reductionist in that all phenomena are reduced to brain processes, and social psychological behaviours may not be reducible to the neuroscience level of analysis (Harmon-Jones & Devine 2003).

Farah et al (2008) raised the issue of privacy of personal thoughts and behaviours with the use of neuroimaging. They coined the term "brainotyping" to describe the search for "features of brain function relevant to an individual's traits". For example, participants take part in what they think is a neuroimaging experiment on face perception, which is really testing their unconscious racial attitudes towards Black and White faces. How realistic is the risk of "mind reading" and this issue of privacy of thoughts and behaviour with neuroimaging technology?

> It is clear that measurement of psychological traits using neuroimaging is, in principle, possible, and that such a use raises ethical concerns. However, it is not clear whether such measurement is a likely development in the near term, a more remote but still realistic goal for the future, or whether it remains effectively a science fiction scenario (Farah et al 2008 p119).

Farah et al (2008) found sixteen studies that investigated personality traits with fMRI. The researchers concluded that activity in certain brain regions were predictive of individual differences, and that "a modest degree of brainotyping capability already exists". However, using fMRI in this way involves certain assumptions. For example, individuals with activity in one particular area of the brain that is one standard deviation below the average when performing a task, an

assumption can be made about their personality. Canli et al (2004) used an emotional Stroop task to measure extraversion based on activity in the anterior cingulate. One standard deviation below the average in brain activity was a sign of low extraversion. The fMRI could be telling the researchers something that the individual may not know themselves or may want to keep private.

Traditionally, fMRI studies have ignored the brain activity while resting as background noise and concentrated upon the neural activity during the task of the experiment. But the energy consumed during the brain "resting" can be twenty times that of conscious activity. This has led to interest in the brain system known as the "default mode network" (DMN) (Raichle 2010).

Fox and Raichle (2007) reported experiments asking participants to visually inspect pictures while inside the fMRI scanner. The researchers found it hard to distinguish the brain activity of the resting state (control condition) and the experimental condition involving a conscious cognitive task. There was only a 5% increase in energy consumption by the brain for the conscious task.

Most of the activity in the brain in the resting state or doing a conscious task was unrelated to external events. This has been called the brain's "dark energy" (Raichle 2010).

The DMN or dark energy is now known to involve the medial parietal cortex and medial prefrontal cortex in the right hemisphere, and the medial prefrontal cortex, lateral parietal cortex and lateral temporal cortex in the left hemisphere (Raichle 2010). Activity in the DMN, in the form of slow cortical potentials (SCP) (groups of neurons firing every ten seconds), is reduced when conscious focused thought is used.

APPENDIX A - LIEBERMAN ET AL (2001)

The theory of cognitive dissonance (Festinger 1957) proposed that if attitudes and behaviour are discrepant, this produces psychological discomfort which has to be resolved. The resolution being a change in attitude. For example, an individual puts a lot of effort in to achieving a desirable goal, like hunting around many shops for a particular music CD, but the goal is less rewarding than expected. The CD is not as good as expected. There is cognitive dissonance between the effort expended and the disappointment over the CD, which is resolved by an attitude change that, say, the CD is great.

Such revision of attitudes may be viewed as rationalisation or self-deception, and as insincere (Lieberman et al 2001). This is because it was assumed that explicit memory was involved (ie: recalling the effort and disappointment), but Lieberman et al found that attitude change can occur even without conscious recall of these things.

In the first experiment, Lieberman et al recruited twelve individuals with anterograde amnesia (problems with forming new memories) due to temporal lobe damage or Korsakoff's syndrome, and twelve age-matched controls (mean age: 62 years old). The participants were asked to rank fifteen pictures (postcard-sized prints of paintings; eg: Monet) in order of preference. Then, after a filler task, they were asked to choose between pairs of pictures as to which they would like to take home. The pairings were made up of pictures previously rated high or low. After another filler task, participants rated the fifteen pictures in order of preference again. A memory test for the pictures was also performed.

The aim of the experiment was to create cognitive dissonance by participants choosing a picture to take home that they had previously rated low, and to see if their attitude towards that picture changed positively.

Both groups of participants showed a positive attitude change towards the pictures that they choose to take home, and a negative attitude change for the pictures rejected (table 1). This was not the case for pictures where no choice was involved.

In terms of recall of pictures in the memory test, there was no relationship with attitude change. In other words, attitude change occurred without explicit memory of the initial rankings and the choice of pictures.

	AMNESIACS	CONTROLS
Selected pictures	+1.13	+0.86
Rejected pictures	-1.20	-1.12

(After Lieberman et al 2001)

Table 1 - Mean change in rankings of pictures.

Lieberman et al also established that conscious attention was not required for attitude change in their second experiment. With only Harvard University undergraduates, a similar design to experiment 1 was used, but the demand on attentional resources was varied. In one condition of picture choice, the participants had to count the number of tones played in the background. The same pattern of results was found as experiment 1, and attentional task had no effect on attitude change. Again this suggested that cognitive dissonance-induced attitude change is an automatic process (with neither conscious attention or recall) [4].

[4] Festinger himself had argued that conscious attention was required for dissonance reduction (Lieberman et al 2001).

REFERENCES

Bartels, A & Zeki, S (2000) The neural basis of romantic love NeuroReport 11, 3829-3834

Bennett, C.M & Miller, M.B (2010) How reliable are the results from functional magnetic resonance imaging? Annals of the New York Academy of Sciences 1191, 133-155

Blakemore, S-J et al (2004) Social cognitive neuroscience: Where are we heading? Trends in Cognitive Science 8, 5, 216-222

Cacioppo, J.T & Berntson, G.G (1992) Social psychological contributions to the decade of the brain: Doctrine of multilevel analysis American Psychologist 47, 1019-1028

Cacioppo, J.T & Visser, P.S (2003) Political psychology and social neuroscience: Strange bedfellows or comrades in arms? Political Psychology 24, 4, 647-656

Cacioppo, J.T et al (2003) Just because you're imaging the brain doesn't mean you can stop using your head: A primer and set of first principles Journal of Personality and Social Psychology 85, 4, 650-661

Cacioppo, J.T et al (2007) Social neuroscience: Progress and implications for mental health Perspectives on Psychological Science 2, 2, 99-123

Canli, T et al (2004) A double dissociation between mood states and personality traits in the anterior cingulated Behavioural Neuroscience 118, 897-904

Castelli, F et al (2000) Movement and mind: A functional imaging study of perception and interpretation of complex intentional movement pattern Neuroimage 12, 314-325

Cunningham, W.A et al (2003) Neural components of social evaluation Journal of Personality and Social Psychology 85, 4, 639-649

Farah, M.J et al (2008) Brain imaging and brain privacy: A realistic concern? Journal of Cognitive Neuroscience 21, 1, 119-127

Fazio, R.H et al (1986) On the automatic activation of attitudes Journal of Personality and Social Psychology 50, 229-238

Ferguson, J.N et al (2000) Social amnesia in mice lacking the oxytocin gene Nature Genetics 25, 284-288

Festinger, L (1957) A Theory of Cognitive Dissonance Evanston, Ill: Row, Peterson

Fletcher, P.C et al (1995) Other minds in the brain: A functional imaging study of "theory of mind" in story comprehension Cognition 57, 109-128

Fox, M.D & Raichle, M.E (2007) Spontaneous fluctuations in brain activity observed with functional magnetic resonance imaging Nature Reviews Neuroscience 8, 700-711

Fox, N.A et al (1995) Frontal activation asymmetry and social competence at four years of age Child Development 66, 1770-1784

Gallese, V et al (1996) Action recognition in the pre-motor cortex Brain 119, 593-609

Haber, S.N & Barchas, P.R (1983) The regulatory effect of social rank on behaviour after amphetamine administration. In Barchas, P.R (ed) Social Hierarchies: Essays Toward a Sociophysiological Perspective Westport, CT: Greenwood

Harmon-Jones, E & Devine, P.G (2003) Introduction to the special section on social neuroscience: Promise and caveats Journal of Personality and Social Psychology 85, 4, 589-593

Lieberman, M.D et al (2001) Do amnesiacs exhibit cognitive dissonance reduction? The role of explicit memory and attention in attitude change Psychological Science 12, 135-140

Lovett, R.A (2010) Reproducibility of brainscan studies questioned Nature (online 17/3; doi: 10.1038/news.2010.129)

Mitchell, J.P (2008) Contributions of functional neuroimaging to the study of social cognition Current Directions in Psychological Science 17, 2, 142-146

Mitchell, J.P et al (2004) Encoding specific effects of social cognition on the neural correlates of subsequent memory Journal of Neuroscience 24, 4912-4917

Phelps, E.A et al (2000) Performance in indirect measure of race evaluation predicts amygdala activation Journal of Cognitive Neuroscience 12, 729-738

Phelps, E.A et al (2003) Intact performance on an indirect measure of race bias following amygdala damage Neuropsychologia 41, 203-208

Raichle, M.E (2003) Social neuroscience: A role for brain imaging Political Psychology 24, 4, 759-764

Raichle, M.E (2010) The brain's dark energy Scientific American March, 28-33

Rizzolatti, G et al (1996) Localisation of grasp representations in humans by PET: 1. Observation vs. execution Experimental Brain Research 111, 246-252

Savulescu, J (2010) speaking on Analysis: Minds Of Your Own? BBC Radio 4, 15/3

Tallis, R (2010) speaking on Analysis: Minds Of Your Own? BBC Radio 4, 15/3

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